NOTES ON THE ANATOMY OF *VICTAPHANTA ATRAMENTARIA* (Shuttleworth) AND *V. COMPACTA* (Cox and Hedley), AND THE DESIGNATION OF A NEOTYPE FOR *V. ATRAMENTARIA*.

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Plate 2

SUMMARY

A neotype for *Victaphanta atramentaria* (Shuttleworth) is designated, and its anatomy is described and compared with that of *V. compacta* (Cox and Hedley).

INTRODUCTION

During work on the redescription of the genus *Victaphanta* Iredale (Smith, 1969) an extensive search for the type specimen of *Victaphanta atramentaria* (Shuttleworth, 1852) failed to reveal its whereabouts. This created a problem as the two species of the genus are very closely similar and the type locality in the original description was not sufficiently specific to enable separation of the species on geographical criteria. The confusion was further aggravated because *V. atramentaria* is the type species of the genus. It was therefore decided that as sufficient steps had been taken to trace the type, and having failed to do so, that, in the interests of stability of nomenclature, a neotype should be designated. It was also thought necessary to redescribe the two species and fully describe their anatomy since work by Kondo (1943) and Solem (1959) has shown how vital the knowledge of the anatomy of this group is to the full understanding of the correct relationships of related species.

DESCRIPTIONS

Victaphanta atramentaria (Shuttleworth, 1852)

Pl. 2, fig. 1a-d.

Nanina atramentaria Shuttleworth, 1852, *Mitt. Naturf. Ges. Bern.*, p. 194.

Helix (Nanina) atramentaria. Pfeiffer, 1853. *Monographia Heliceorum Viventium Lipsiae*, 3: 630.

Paryphanta atramentaria. Menke and Pfeiffer, 1854, *Malakozoologische Blatter, Cassel*, 2: 122.

Nanina (Paryphanta) atramentaria. Shuttleworth, 1856, *Notitiae Malacologicae*, Leipzig, 1: 16.

Paryphanta atramentaria. Adams and Adams, 1858, *Genera of Recent Mollusca*, Van Voorst, London, 2: 226.

Helix atramentaria. Pfeiffer, 1859, *Monographia Heliceorum Viventium, Lipsiae*, 4: 8.

Paryphanta atramentaria. Albers, 1861, *Die Heliceen*, Leipzig, p. 48.

Helix (Paryphanta) atramentaria. Cox, 1868, *Monograph of Australian Land Shells*, Sydney, p. 5, pl. 3, fig 2 a - b.

Nanina (Paryphanta) atramentaria. Shuttleworth, 1877. *Notitiae Malacologicae*, Leipzig, 2: 5, pl. 1. fig 2.

Paryphanta atramentaria. Tryon, 1885, *Man. Conch.*, (2), 1: 127, pl. 26, figs. 5 - 6.

Paryphanta atramentaria. Cox and Hedley, 1912, *Mem. Natn. Mus. Vict.*, 4: 8.

Victaphanta atramentaria. Iredale, 1933, *Rec. Aust. Mus.*, 19: 60.

Victaphanta atramentaria. Iredale, 1938, *Aust. Zool.*, 9: 116.

Victaphanta atramentaria. Smith, 1939, *Proceedings of Symposium on Mollusca, India*, part 1, p. 164-169.

Diagnosis: Paryphantid snail of the genus *Victaphanta*, shell depressedly globose, thin, glossy, four whorls white to yellow to dark brown or black on the outer whorls, umbilicus narrowly open with the internal spire visible, fine concentric lines on upper surface, lower surface smooth, reaches 34 mm maximum diameter. Animal black with orange frill around foot, foot white, mucus orange and viscous. Pharynx long cylindrical, radula without rachidian, teeth unicuspid with oblong base-plate bearing a notch at posterior extremity. Reproductive system simple, vas deferens free from common duct, attached to the outer wall of the vagina, running in a loop past the genital atrium and entering the penis just before its posterior end; penis equal in length to the vagina.

Distribution: This species is confined to the temperate rain-forest areas of the Dandenong Ranges and the east-central part of the Great Dividing Range in Victoria. It is only found in the wet litter in fern gullies in climax rain-forest. The original type locality was given as Port Phillip which is the old name for the colony area surrounding Melbourne which was later changed to Victoria. The original specimen must have been collected in the 1840's and no more exact record of locality is given. All distribution records except one fall within a 1,500 sq. mile area bounded in the north by Marysville, the south by Neerim, the east by Wood's Point and the west by Mount Dandenong. The one anomalous record is by Cox (1868) who records it from Bendigo. However this is so long ago and he associates it with Mount Arnold which is within the area described above and many of Cox's localities have been proved erroneous (Mrs. J. Richardson — personal communication) that this record can be discounted.

Neotype: National Museum of Victoria No. F27376 from Gentle Annie Camp at junction of Labertouche, Neerim, and Powelltown roads near 1448 feet marker (State Aerial Survey of Victoria — Sheet Gembrook D, Ref. 823206); collected by B.J. Smith on 8 November, 1966. Neotype narcotized using a nicotine solution, preserved by injecting with Formol/ Calcium and stored in a formalin-glycerine-Perminal fluid. Major diameter 31.62 mm, minor diameter 26.50 mm, maximum height of shell 17.76 mm.

Fate of Original Type: Shuttleworth's collection and types all went to Berne and Basle Museums in Switzerland (Dance, 1966). Requests were therefore made to these two museums and also to the museums in Zurich, Geneva and Neuchatel in Switzerland and to the Natural History Museums in Paris and London. Dr. J. Oberling in Berne informed me that the type was missing from the Shuttleworth Collection held in that institution, together with many other type specimens. All the other museums, except Zurich, failed to find any material which could be relevant to this search. Dr. H. Jungen of Zurich University Museum informed me of a specimen of this species in the Mousson Collection which Mousson was believed to have obtained from Shuttleworth. Through the good offices of the Zurich Museum this specimen was sent on loan. The label with this specimen states '*Par. atramentaria* Shttl. 2, Victoria (Shuttlew. 67) ' and there is a small label inside the shell with the species name: *atramentaria.*

Dr. Jungen, and through him Frl. V. Gerber of the Berne Museum, informed me that the large label is in Mousson's handwriting while the small label inside the shell could possibly be in Shuttleworth's handwriting but they could not be certain of this. No label could be found from Shuttleworth with any dates or other data which would indicate that this specimen was the type. Therefore because no direct documentary evidence exists and because Mousson records the genus as *Paryphanta* and not *Nanina* and the locality as Victoria and not Port Phillip, as in the original description, a grave doubt is thrown on this specimen being the original type specimen.

The dimensions of this specimen are: Max. dia. 31 mm, min. dia. 25.7 mm, height 16 mm compared with 30 mm, 24 mm, 14 mm from the type description. The species was not figured when it was described and the earliest figure of an authentic nature is found in *Not. Malac.*, 2: pl. 1, fig. 2. This was from Shuttleworth but was published by Fischer in 1877, after the death of Shuttleworth. It could be reasonably assumed that the figures were drawn from the type. If so then the specimen in the Mousson Collection at the Zurich Museum is not the type as the drawing shows an obvious abnormal growth fold not present in the Mousson specimen. Taking all these factors into consideration it is therefore reasonable to assume that the specimen from the Mousson Collection in Zurich is not the type specimen, and as the type can be located nowhere else, it must be presumed lost.

Comparison with the Original Type: Because of the brevity of the original description and the close similarity of the two species of the genus there is little in the original description to distinguish to which species the original specimen belonged. However it has recently been shown (Smith, 1969) that the two species can be distinguished on a statistical basis by shell shape, *V. compacta* being significantly more globular in shape than *V. atramentaria.* If the shape of the original type specimen is considered in this way, it more nearly approaches the *V. atramentaria* group than the *V. compacta* group. Also its maximum diameter exceeds the maximum diameter found for any specimen of *V. compacta.* It can therefore be assumed that the neotype is consistent with the original type material.

Victaphanta compacta (Cox & Hedley, 1912)

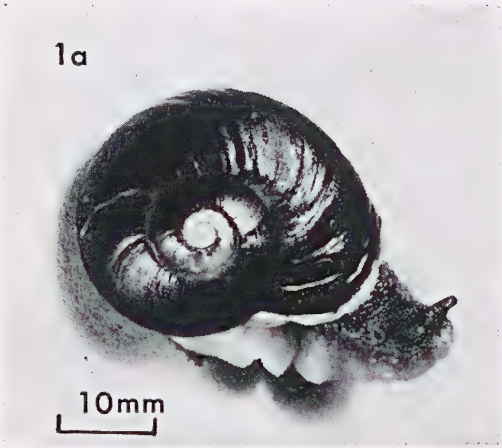
Pl. 2, fig. 2a-b.

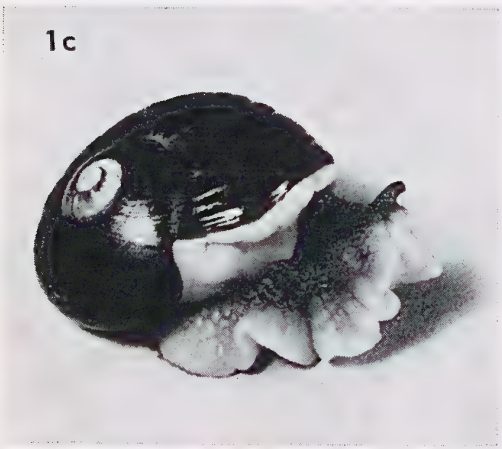
Paryphanta compacta Cox and Hedley, 1912, *Mem. Natn. Mus. Vict.*, 4: 8. pl. 1, figs. 3 - 5.
Victaphanta compacta. Iredale, 1938, *Aust. Zool.*, 9: 116.
Victaphanta compacta. Smith 1969, *Proceedings of Symposium on Mollusca, India,* part 1, p. 164 - 169.

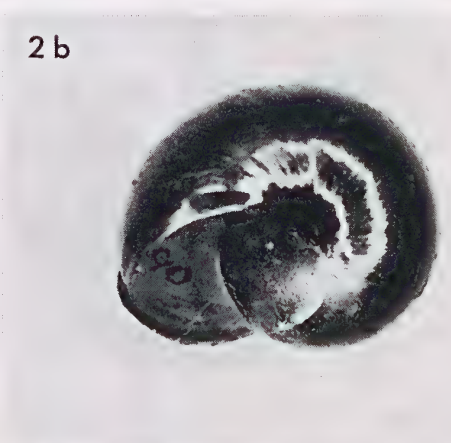
Diagnosis: Paryphantid snail of the genus *Victaphanta,* shell more globular than *V. atramentaria,* four to five whorls, yellow to dark brown, rarely black, umbilicus nearly closed by reflection of the inner insertion of the aperture margin, reaches 28 mm maximum diameter. Animal black with no orange pigment in skin or mucus, mucus colourless and less viscous than *V. atramentaria.* Radula teeth unicuspid, tooth base-plate without posterior notch. Penis shorter in length than vagina and vas deferens enters at the posterior extremity of the penis.

Type Material: Type in the Australian Museum — C31179 collected by Mr. A. D. Hardy from Smithers Creek, Otway Ranges, Victoria; dimensions (from original description) Maj. diam. 24 mm; min. diam. 19 mm;

PLATE 2







height 17 mm. The specimen is badly split and no measurement is now possible. Three paratypes in the National Museum of Victoria — F 690, collected by Mr. Kershaw at Erskine Falls, Loutit Bay, near Lorne, Victoria; dimensions. Paratype 1 (Figured), maj. diam. 20 mm; min. diam. 15.5 mm; height 14.5 mm, paratype 2, maj. diam. 19 mm; min. diam. 15.5 mm; height 14 mm, paratype 3, Maj. diam. 19.5 mm; min. diam. 16 mm; height 13.5 mm.

Distribution: This species is confined to the temperate rain forest in the Otway Ranges in the south-western part of Victoria. It is confined to a triangle of approximately 250 sq. miles in area from Lorne to Cape Otway to Gellibrand. However because of extensive land clearance it is only found in pockets of untouched forest within that area.

ANATOMY

Four specimens of each species were narcotized using a nicotine solution, injected with 5% formalin solution and stored in a formalin — glycerine — Perminal fluid. These were used for the dissection to describe the anatomy. The anatomy of *V. atramentaria* was described by Murdoch (1906) and of both species by Davies (1913). However a number of features now considered of systematic significance were omitted from these descriptions. As the anatomical differences between the two species are so slight and few in number, the following descriptions refer to both species except where otherwise stated.

Pallial Region. (Fig. 3). The pallial cavity is large, approximately five times the length of the kidney, with a large heavy mantle collar. The pulmonary orifice is deeply depressed with two large triangular lappets. The hindgut follows the parietal-palatal margin for the length of the pallial cavity, terminating a short distance before the pulmonary orifice into a deep grove in the ventral part of the orifice. On the posterior margin of the collar is a large white area in *V. atramentaria*, similar to the mantle gland described in *Ouagapia sp.* by Kondo (1943). The kidney is a small light brown triangular curved organ next to the heart with the ureter, a wide thin walled tube, emerging at its apex and reflexing posteriad on the left side. It appears to terminate here in an indistinct orifice which exhausts into a " secondary pseudoureter " which consists of a channel next to the rectum enclosed by a thin membrane. This appears to open into the pulmonary orifice groove next to the anus. The heart gives rise to an extensive vessel system covering the entire dorsal wall of the pallial cavity.

Alimentary System. (Fig. 4). The alimentary system is completely specialised for the carnivorous habit. The mouth is simple leading into a strongly muscular cylindrical pharynx as long as the body cavity. This is attached on the ventral surface to columellar muscle by the large pharyngeal retractor muscle. The œsophagus arises as a narrow tube from the dorsal surface of the pharynx and about one third of the way along its length. The salivary gland is a single ovoid gland dorsally placed on the œsophagus and opening by two long fine salivary ducts into the œsophagus at its junction with the pharynx. The œsophagus is short and simple and leads into an expanded crop with thin walls with numerous

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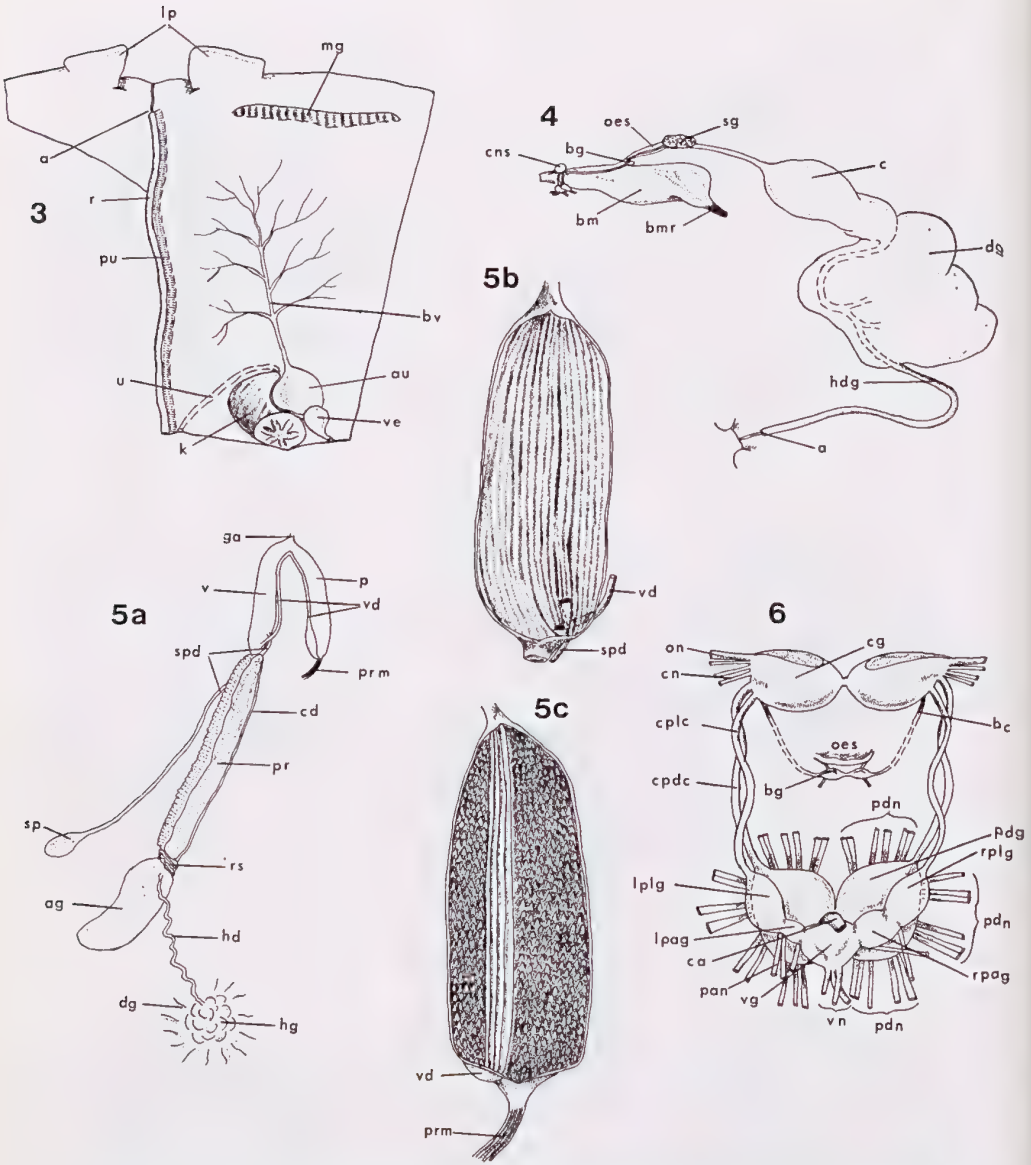
PLATE 2

Figure 1. *Victaphanta atramentaria* Shuttleworth. Neotype (NMV No. 27376) showing (a) dorsal view, (b) ventral view, (c) view from the right side and (d) view from the left side.

Figure 2. *Victaphanta compacta* Cox and Hedley. Paratype (NMV No. F690) showing (a) dorsal and (b) ventral views.



Figures 3 - 6. *Victaphanta atramentaria*. 3, Diagram of the pallial region. 4, Diagram of the alimentary system. 5, Diagram of the reproductive system showing (a) a general view, (b) the internal structure of the vagina and (c) the internal structure of the penis. 6, Diagram of the central nervous system viewed from the posterior.

fine longitudinal folds. From here the intestine coils and is embedded in the digestive gland which occupies all the left and dorsal part of the second body whorl and the remaining whorls. The intestine sends several diverticulæ into the digestive gland. The hindgut then runs along the

ventro-lateral margin of the pallial cavity and exhausts at the anus into the ventral groove of the pulmonary orifice. The radulæ of the two species were compared recently by Smith (1969).

Reproductive System. (Fig. 5a, b, c.) The species are oviparous, laying large, white, hard-shelled eggs approximately 2 - 3 mm in diameter. The reproductive system is simple. The hermaphrodite gland is a small lobate structure, consisting of an indeterminate number of small lobules rather than one or two easily recognisable lobes, embedded in the latero-ventral part of the digestive gland with about 1½ whorls of digestive gland above it. The hermaphrodite duct is a long, thin, convoluted duct which enters the swollen end of the receptaculum seminalis which is embedded in the anterior end of the albumen gland. To do this it appears that the hermaphrodite duct passes through the anterior end of the albumen gland and enters the receptaculum seminalis from the ventral side.

The receptaculum seminalis is a bipartite structure with the large second lobe appearing to be divided into two on the ventral side. It appears as a compressed white structure between the large yellow albumen gland and the salmon coloured common duct.

The common duct in the mature animal is about one and a half times the length of the vagina and consists in life of a salmon coloured convoluted longitudinal half on the right side and a blue-grey smooth left half. The convoluted salmon part comprises the thin glandular wall of the single duct forming the common duct while the blue-grey area comprises a large prostate gland consisting of small alveolar-like acini inside a thin outer membrane. From sections these appeared to open into the single common duct at intervals along its length by small connecting ducts.

The common duct ends with the termination of the prostate gland and enters the long muscular vagina. At this point the vas deferens emerges and runs as a fine, free duct up the right side of the vagina to the genital atrium where it forms a sharp loop, becomes embedded in the outer connective tissue of the penis and runs down the left side of the penis to enter by a dilated end into the posterior part of the penis near the insertion of the penal retractor muscle. Also at the junction of the vagina and common duct a fine duct emerges from the vagina and runs down the ventral side of the common duct. This is the spermathecal duct which terminates in the small sac-like spermatheca which is found ventral to the region where the hindgut deflects close to the auricle. It therefore deflects away from the common duct before reaching the posterior end of the later and lies ventral to and outside the first digestive gland lobe.

The vagina is a long, narrow tubular structure approximately two-thirds of the length of the common duct. At its distal end emerges the vas deferens and the spermathecal duct and it terminates in the small genital atrium at its proximal end. Its internal surface is made up of many fine longitudinal folds which show no recognisable tracts or structural differentiation in the region of the outlets of the two ducts at the distal end. Some of the folds seem to be continuous for the full length of the organ while others extend for a short distance only.

The penis is also a long, narrow, tubular organ which leads into the genital atrium at its proximal end. In *V. compacta* the vas deferens enters at the posterior extremity of the penis and the penis is slightly shorter in

length than the vagina. In *V. atramentaria* the vas deferens enters the penis a short distance from the end and the penis is equal in length to the vagina. The penis retractor muscle is a long broad band of muscle inserting into the apex of the penis and having its origin on the floor of the mantle cavity near the mantle collar on the right side. The internal surface of the penis in both species is identical, being made up of two or three fairly deep grooves running from the point of entry of the vas deferens to the genital atrium. The remainder of the internal surface is covered with conical papillæ and shows no special structures or arrangement.

Nervous System. (Fig. 6). The central nervous system consists of a nerve ring permanently situated in a small constriction in the pharynx immediately posterior to the mouth and anterior to the origin of the œsophagus. Because of the size of the pharynx the cerebro-pleural and cerebro-pedal commissures are very long and flexible. The cerebro-buccal commissures are also very long and flexible originating from the latero-ventral margins of the cerebral ganglia and running posteriad to the buccal ganglia immediately posterior to the origin of the œsophagus from the pharynx. The pair of buccal ganglia give off three pairs of nerves to the œsophagus, and the pharynx.

The cerebral ganglia are a pair of oval bodies on the dorsal side of the pharynx joined by a very short inter-cerebral commissure. The entire nerve ring is enveloped in a thin connective tissue sheath which, while being thin enough to make the ganglia easily visible, obscures the origins and exact number of many of the nerves. At the anterior end of each cerebral ganglia is a small opaque area at the base of the optic nerve. This probably corresponds to an area of small cells in a similar position described for many pulmonates (Lever et al, 1961; Smith, 1966). Apart from these nerves and the commissures described above, the cerebral ganglia also give rise to nerves running to the optic and inferior tentacles and their retractor muscles and to the pharynx and anterior sensory areas.

The sub-pharyngeal part of the central nervous system consists of two large ovoid pedal ganglia with commissures joining them to the pleural and cerebral ganglia and to each other and with approximately ten to sixteen nerves or nerve trunks arising from their anterior, lateral and posterior sides and running to all parts of the foot and integument. Dorsal to the pedal ganglia is the pleuro-parieto-visceral ganglion complex with the cephalic artery passing between. The two lateral ganglia of this ganglion complex, the left and right pleural ganglia, receive commissures from the cerebral and pedal ganglia but appear to have no nerves originating from them. The left pleural ganglion is slightly larger than the right. The two ganglia fused to, and central to the pleurals, are the left and right parietal ganglia, the right one being much larger than the left, which is almost lost. However, the left parietal forms the origin for three nerves to the tentacular and pharyngeal retractor muscles and to parts of the foot and pedal gland. The right parietal ganglia gives rise to two nerves to the tentacular and penis retractor muscles and to parts of the integument and mantle cavity floor. The single visceral ganglion, which lies posterior to and joins with the parietal ganglia, consists of a small triangular ganglion giving rise to three large nerve trunks from its posterior apex. These innervate the mid and hind gut, the vagina and common duct and the heart and renal structures. A more detailed survey of the nervous system of these two species is proposed as future study.

ACKNOWLEDGEMENTS

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REFERENCES

COX, J. C., 1868. *A Monograph of Australian Land Shells.* Sydney.

COX, J. C., and C. HEDLEY, 1912. An index to the land shells of Victoria. *Mem. Natn. Mus. Vict.*, 4: 1 - 11.

DANCE, S. P., 1966. *Shell Collecting, An Illustrated History.* Faber and Faber, London.

DAVIES, O. B., 1913. The anatomy of two Australian land snails, *Paryphanta atramentaria* Shuttleworth and *P. compacta* Cox and Hedley. *Proc. R. Soc. Vict.*, 25: 221-228, pl. 15 - 17.

KONDO, Y., 1943. Anatomical studies of three species of *Ouagapia* (Pulmonata, Agnatha, Paryphantidae). *Occ. Pap. B. P. Bishop Mus.*, 17 (19) : 229 - 248.

LEVER, J., M. KOK, E. A. MEULEMAN and J. JOOSE, 1961. On the location of gommori-positive neurosecretory cells in the central ganglion of *Lymnaea stagnalis*. *Proc. Acad. Sci. Amst.*, C64: 640 - 647.

MURDOCH, R., 1906. On the anatomy of *Paryphanta atramentaria* Shuttleworth. *Trans. N.Z. Inst.*, 38: 313 - 316.

SHUTTLEWORTH, R. J., 1852. *Mitth. Natf. Ges. Bern*, p. 194.

SMITH, B. J., 1966. The structure of the central nervous system of the slug *Arion ater L.*, with notes on the cytoplasmic inclusions of the neurons. *J. Comp. Neur.*, 126: 437 - 452.

——— 1969. A comparative study of two Australian paryphantid snails, with notes on their taxonomic relationships. *Proceedings of Symposium on Mollusca, India*, part 1: 164 - 199.

SOLEM, A., 1959. Systematics and zoogeography of the land and freshwater mollusca of the New Hebrides. *Fieldiana*, 43: 1 - 359.

ABBREVIATIONS

a — anus
ag — albumen gland
au — auricle
bc — buccal commissure
bc — buccal ganglion
bm — buccal mass
bmr — buccal mass retractor
bv — blood vessel
c — crop
ca — cephalic artery
cd — common duct
cg — cerebral ganglion
cn — cephalic nerve
cns — central nervous system
cpdc — cerebro-pedal commissure
cplc — cerebro-pleural commissure
dg — digestive gland
ga — genital atrium
hd — hermaphrodite duct
hdg — hind gut
hg — hermaphrodite gland
k — kidney
lp — lappet
lpag — left parietal ganglion
lplg — left pleural ganglion
mg — mantle gland
oes — oesophagus
on — optic nerve
p — penis
pan — parietal nerve
pdn — pedal nerve
pr — prostate gland
prm — penal retractor muscle
pu — pseudo-ureter
r — rectum
rpag — right parietal ganglion
rplg — right pleural ganglion
rs — receptaculum seminalis
sg — salivary gland
sp — spermatheca
spd — spermathecal duct
u — ureter
v — vagina
vd — vas deferens
ve — ventricle
vg — visceral ganglion
vn — visceral nerve